How do you project an isochronous simulation with SIMIT and PLCSIM Advanced?

SIMIT 10.3 Upd1 / PLCSim Advanced V4.0 SP1

https://support.industry.siemens.com/cs/ww/en/view/109808735

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Table of content

1 Software requirements

This FAQ has been created with the following software components:

Table 1-1 Software used

Component	Article number	Entry ID
SIMATIC S7-PLCSIM Advanced 4.0 SP1	6ES7823-1FA03-0YA	-
SIMIT S V10.3 Upd1	6DL8913-0AK30-0AB5	-
HWCN Exporter V10.03.00.00_24.01.00.01	-	109770995
Correction of the V3.0 API version	-	109802065

NOTE

Download: HWCN Exporter

https://support.industry.siemens.com/cs/ww/en/view/109770995

NOTE

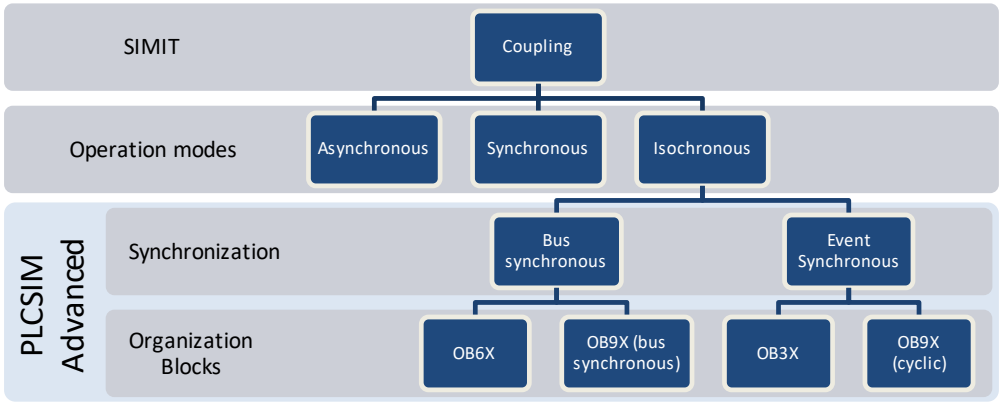
It is required to at least update the software to the versions above. When using S7-PLCSim Advanced V4.0, make sure to install the correction of the V3.0 API:

https://support.industry.siemens.com/cs/ww/en/view/109802065

2 Overview

SIMIT offers three different operation modes (see Figure 2-1). When a PLCSIM Advanced coupling is existing and isochronous mode is selected synchronization can be done *bus synchronous* or *event synchronous*. Which one of those is selectable depends on the configured OBs.

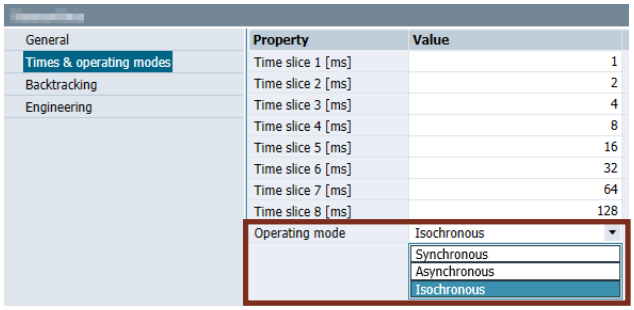
Figure 2-1 System Overview



2.1 Operating modes

The simulation model and the couplings can be processed according to the three different operating modes *asynchronous*, *synchronous,* and *isochronous* (see Figure 2-2). These options can be found in the project manager of SIMIT and are explained in the following.

Figure 2-2 SIMIT Times & operating modes



Asynchronous

Model calculation of the individual time slices and coupling processing is time-controlled. If the simulation model of a time slice does not finish within the allocated time, one or more processing cycles are omitted and the time slices with other cycle times are not calculated.

Synchronous

With synchronous mode, modules and couplings are calculated in a precisely specified sequence. The next action does not start until the previous action has finished. In contrast to asynchronous mode, no control cycles can be dropped.

Synchronous simulation is waiting for provided data and starting model calculation afterwards. Simulation procedure is synchronized but simulation progress isn't. In contrast to isochronous mode, an equal time domain for all simulation partners is not guaranteed.

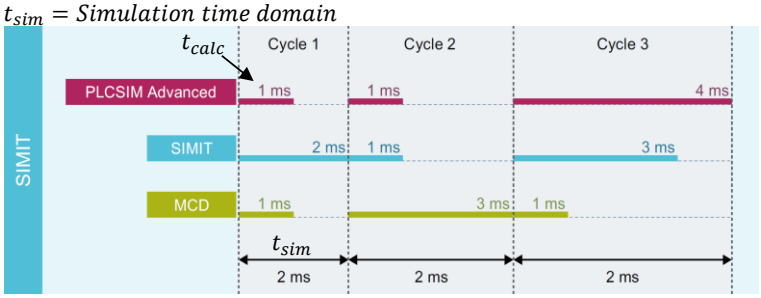
Isochronous

With the isochronous operating mode, SIMIT ensures that all components involved in the simulation have the same synchronized simulation progress and the same time domain. This means that even if calculation time for tasks differs from the set-up cycle time the time domain between all isochronous simulation partners is equal (see Figure 2-3). This operating mode is therefore suitable for applications with time-critical requirements. All simulation participants are waiting for each other.

Figure 2-3 Isochronous operation mode

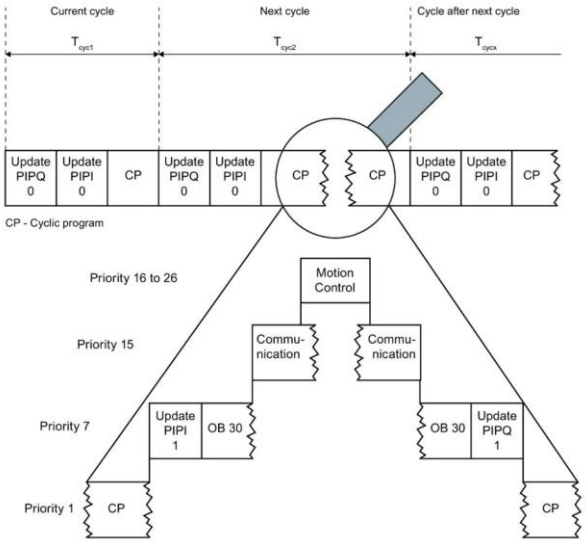
$t_{calc} = Calculation\ time\ of\ simulation\ partner$

$t_{sim} = Simulation\ time\ domain$



Tasks of the PLC will be handled like in Figure 2-4. This is the reason for differing cycle times in the PLC and a resulting slower simulation in isochronous mode.

Figure 2-4 Differing cycle times and process level in the PLC



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More information on the operating modes

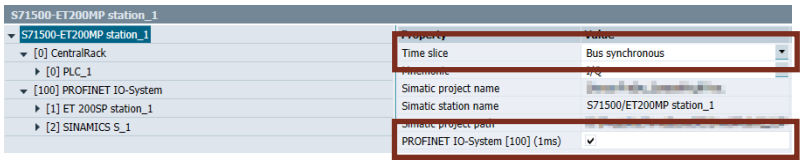
Manual: SIMATIC SIMIT Simulation Platform (V10.3)
https://support.industry.siemens.com/cs/ww/en/view/109801804

2.2 Isochronous PLCSIM Advanced coupling

When adding a new PLCSIM Advanced coupling to the SIMIT Project, it is required to import the hardware configuration by selecting a TIA Project or a HWCNExport-File.

To activate isochronous communication in SIMIT the time slice of the coupling must be set to *bus synchronous* or *event synchronous* (see Figure 2-5). These options are only available if corresponding OBs (see Figure 2-1) are projected in the PLC Project.

Figure 2-5 SIMIT coupling properties for bus synchronous communication



SIMIT shows the projected cycle time of the bus-system (*Bus synchronous*) or the cycle times of the projected OBs (*Event synchronous*) (see Figure 2-5).

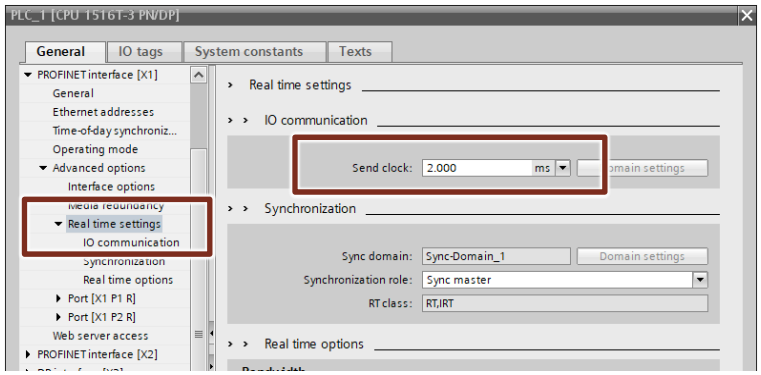
Both technologies are synchronizing on the PIP events in the virtual PLC.

NOTE SIMIT can only handle cycle times as integer values in milliseconds. This also applies to the OBs in the project. Tasks without integer cycle times (e.g., 1.8ms) are shown but not selectable.

2.2.1 Bus synchronous

Bus synchronous communication is dependent on the Profinet-IO cycle time which can be set up in the properties of the PLC in the TIA Project (see Figure 2-6).

Figure 2-6 PLC properties for IO communication



Especially for cyclic OBs IRT is needed for isochronous communication (see Figure 2-7). Make sure IRT is activated in the hardware configuration and the hardware topology is set up correctly (see Figure 2-8).

Figure 2-7 Isochronous mode for decentralized periphery

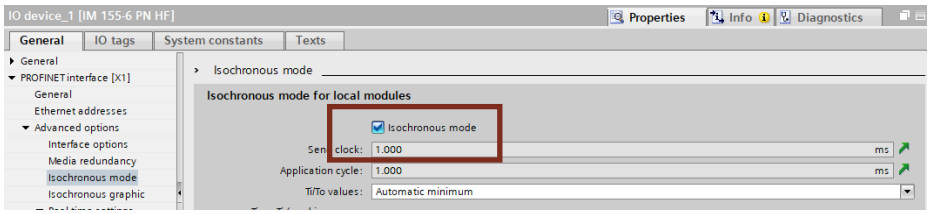
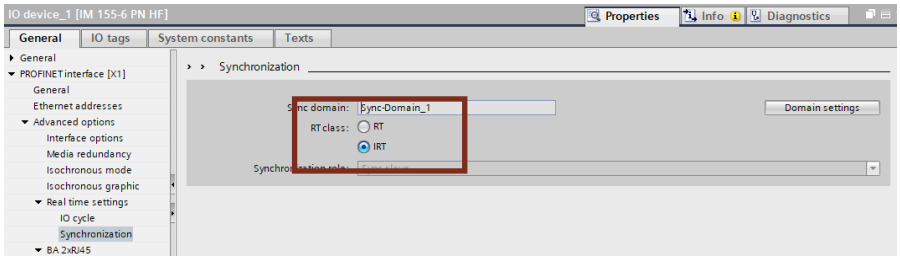


Figure 2-8 IRT setup in decentralized periphery



Select the *bus synchronous* mode for isochronous communication with MC-Servo OB91 (see 3.1 Synchronization to MC-Servo OB91) or Synchronous Cycle OB6X (see 3.3 Synchronization to Synchronous Cycle OB6X). If none of these is used, *bus synchronous* option is not offered.

NOTE

If you call at least more than one isochronous OB (Synchronous cycle OB6X, MC-Servo OB91) isochronously in the same PROFINET-IO system, the same application cycle must be set for them.

https://support.industry.siemens.com/cs/be/en/view/109749263/100323337227

2.2.2 Event synchronous

Event synchronous time slice is mainly used for cyclic interrupt OB3Xs (see 3.2 Synchronization to Cyclic Interrupt OB3X) but it is also possible to synchronize to the MC-Servo OB9X when *cyclic* mode is selected in the properties (see 3.1 Synchronization to MC-Servo OB91).

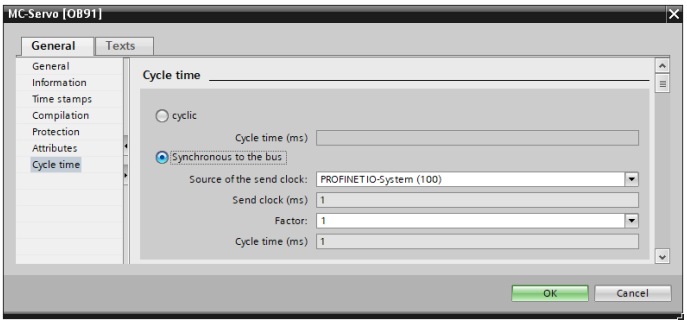
Event synchronous mode does not require an isochronous PLC setup or IRT communication.

3 TIA Project configurations

3.1 Synchronization to MC-Servo OB91

Synchronizing to MC-Servo OB91 should be done in *bus synchronous* mode if possible. To avoid issues in the communication, set the *Cycle time* to *synchronous to the bus* with *Factor 1* (see Figure 3-1). In some projects it is necessary to set different values between the PROFINET-IO cycle time and the MC-Servo cycle time. Check 4.4 Different Profinet-IO and isochronous OB cycle times in that case.

Figure 3-1 MC-Servo OB91 synchronous to the bus



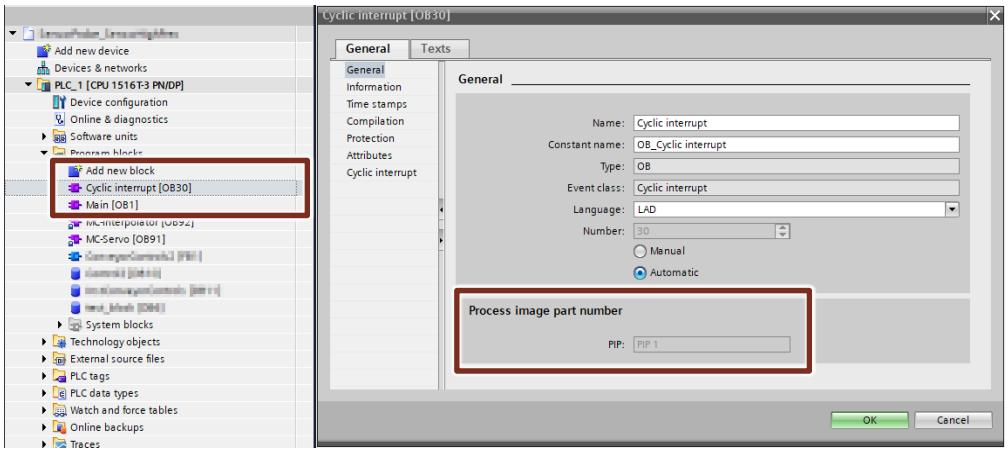
When *cyclic* mode in the MC-Servo OB is selected, MC-Servo is calculated independent from the PROFINET-IO cycle time just like the OB3Xs. Select *event synchronous* in the coupling to synchronize to it in this case. See chapter 5.5 Event Synchronous Mc-Servo for relevant information.

3.2 Synchronization to Cyclic Interrupt OB3X

Synchronizing to cyclic interrupt OBs does not require a configuration of an IRT network or isochronous communication.

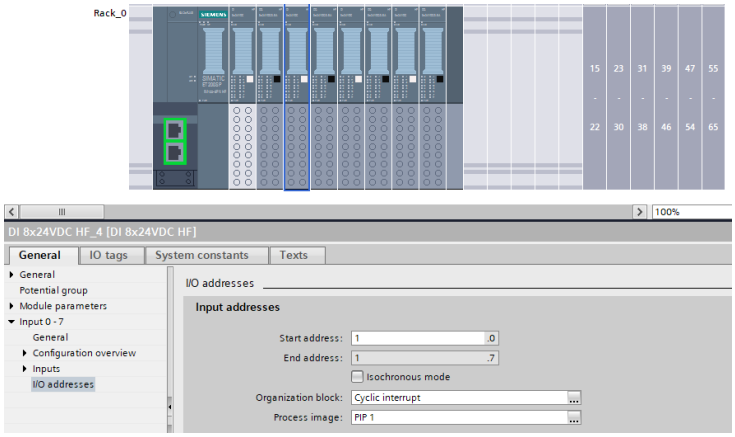
After creating a cyclic interrupt OB in the PLC Program there must be an assigned PIP (see Figure 3-2).

Figure 3-2 Cyclic interrupt OB3X – Process image part number



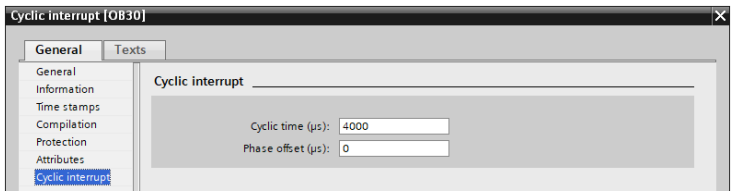
Assigning the PIP is done in the hardware configuration of the project by selecting the desired submodule and choosing the preferred organization block and process image (see Figure 3-2).

Figure 3-3 Assigning PIPs in ET200 submodules



Make sure the cycle time of the interrupt OB is set to an integer multiple of the Profinet cycle time in milliseconds (see Figure 3-4).

Figure 3-4 Cycle time of the cyclic interrupt OB3X

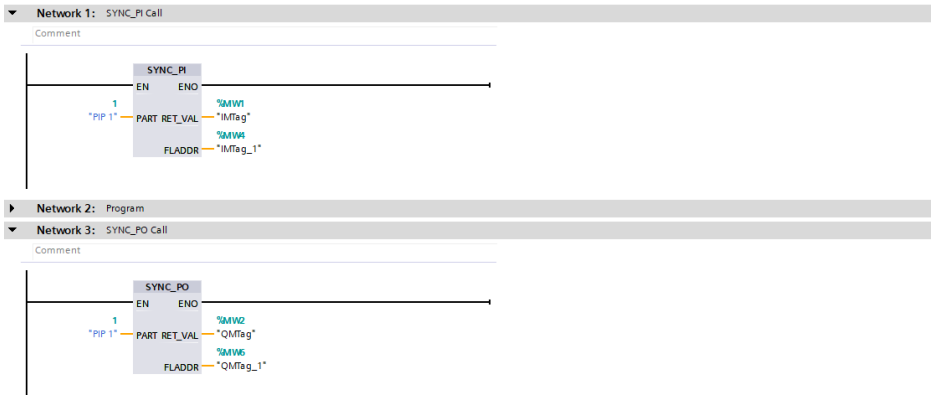


Select the *Event Synchronous* mode in SIMIT to synchronize to it.

3.3 Synchronization to Synchronous Cycle OB6X

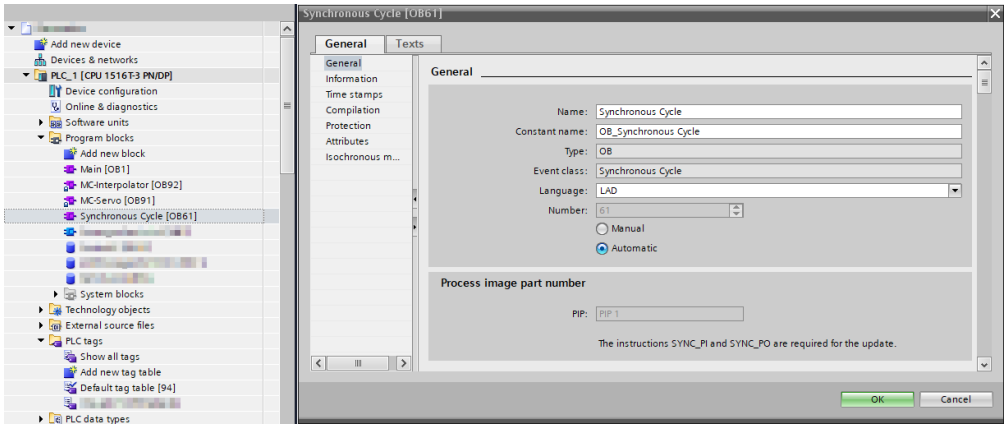
In general synchronizing OB6X and PIPs is only possible if the "SYNC_PI" and "SYNC_PO" functions are called in the OB (see Figure 3-5). If these functions are not called, the PIP events will not be triggered and IOs will not be read/written. When OB6X is the only isochronous OB in the project and the SYNC-functions are not called, the simulation will not run.

Figure 3-5 Call of SYNC_PI, program, and SYNC_PO in OB6X



Make sure that the correct PIP is assigned to the OB (see Figure 3-6). Assigning is done just like for the OB3X (see 3.2 Synchronization to Cyclic Interrupt OB3X) but with selected isochronous mode for OB6X.

Figure 3-6 Synchronous cycle OB6X – Process image part number



Read me

More information on programming the synchronous OB can be found in the FAQ:

Isochronous mode with PROFINET - an example with SIMATIC S7-1500

https://support.industry.siemens.com/cs/ww/en/view/109480489

4 Tips and tricks

4.1 Simulation synchronization without isochronous OBs

In some cases, it is necessary to synchronize the simulation progress with SIMIT and PLCSIM Advanced even if the TIA project does not meet the requirements.

The easiest is adding a dummy OB30 in the TIA Project with associated dummy hardware (e.g., one DI submodule with a PIP assignment). This does not require IRT isochronous communication. After importing the new HWCN-.xml file it will be possible to synchronize the PIP in *event synchronous* mode.

4.2 Selecting OBs for synchronization

If there are isochronous OBs as well as event synchronous OBs in the PLC project available, synchronize to the OB with highest priority. In most cases this is the MC-Servo OB, which should be synchronized in *bus synchronous* operation mode of SIMIT.

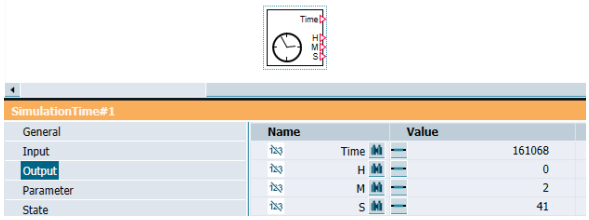
In case *bus synchronous* is not an option, synchronize to the fastest event synchronous OB in *event synchronous* operation mode of SIMIT.

4.3 Debugging isochronous issues

Simulation time

Checking the simulation time in SIMIT can be done with the *SimulationTime* Component (see Figure 4-1) from the *STANDARD - Misc* library.

Figure 4-1 Simulation Time SIMIT



A simulation running twice, or half as fast as real time indicates an error with the isochronous mode configuration. Make sure Profinet-IO cycle time and OB cycle time for *bus synchronous* mode is the same (see 3.1 Synchronization to MC-Servo OB91).

In case MC-Servo must run slower than Profinet-IO cycle time read about 0 Slowed-down simulation.

If the simulation time is not running at all

- check if the plc is running at first. When the PLC is stopped, the simulation is also stopped in isochronous mode.
- check if other isochronous simulation participants are stopped (e.g. MCD).
- check if the IO-image in the PLC and SIMIT is the same.
- check necessary SYNC calls for OB6X (see 3.3 Synchronization to Synchronous Cycle OB6X).
- check if the synchronization is *Event Synchronous* with a *cyclic* Mc-Servo and see chapter 5.5 Event Synchronous Mc-Servo in that case.

IO and drive telegram communication

Tracing the synchronized IOs in the TIA Portal is also a common way to ensure the communication is working. Also make sure that the IOs are not overwritten in the PLC and that the sampling is done with the same OB as the isochronous connection is based on.

Tracing of the following cases is recommended:

- IOs with PIP assignments and isochronous communication
- Drive telegram communication, position and velocity values

Cyclic toggling bits

By creating a cyclic toggling bit from SIMIT which is connected to a bit of an isochronous DI submodule (see Figure 4-2 and Figure 4-3) cyclic communication can be verified. The time slice for those SIMIT components (*Selector* and *Negator*) must be set to the same cycle time as the isochronous connection.

Figure 4-2 Creating a cyclic toggling bit in SIMIT

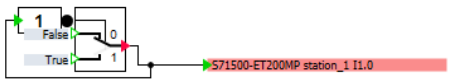
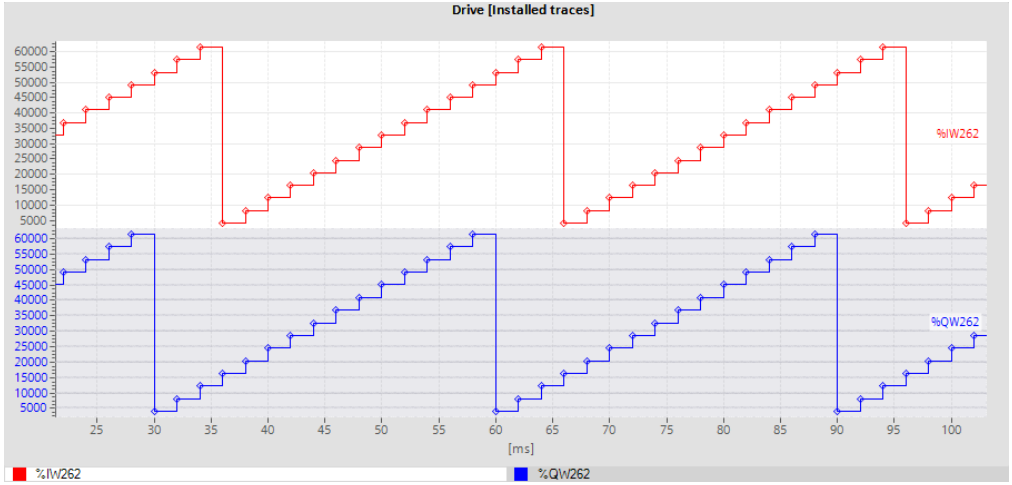


Figure 4-3 Resulting cyclic toggling bits for different OB cycle times

Drive telegram communication

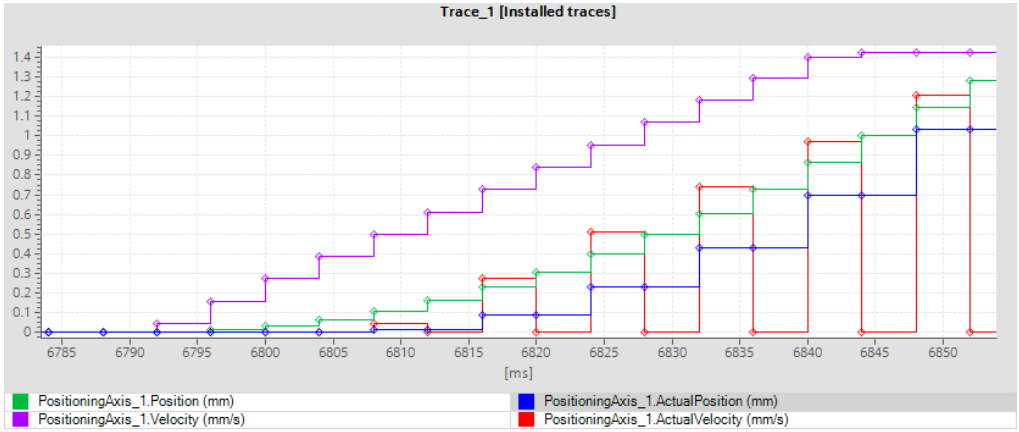
Another way to check the communication is to analyze the telegram communication of the drives. Running the drive will not give information if the communication is flawless. Check the IO-communication in SIMIT by showing the values of the IOs (e.g., STW2 and ZSW2 of the PROFIdrive2 SIMIT block) and trace the IOs in the PLC if necessary (see Figure 4-4).

Figure 4-4 ProfiDrive2 communication of STW2 (%ID262) and ZSW2 (%QD262)



Also check the position and velocity values of the drives. Figure 4-5 shows issues with the drive communication. Position values for every second cycle are not updated (blue line). This results in a velocity of zero in every second cycle (red line). The purple and green line show the target values for position and velocity sent from the PLC.

Figure 4-5 Faulty drive communication



4.4 Different Profinet-IO and isochronous OB cycle times

If different cycle times within Profinet-IO and isochronous OBs (MC-Servo, OB6X) are necessary, make changes within the generated .xml-File of the HWCN-Exporter before importing it to SIMIT.

Open the generated .xml-File and change the cycle time values of the isochronous OBs from “1” to the desired cycle time:

Adjust the *IsochronousTime*:

```
<ATTRIBUTE Name="IsochronousTime" Type="double">1</ATTRIBUTE>
```

Search for the used bus synchronous OBs and set the cycle time:

```
<ATTRIBUTE Name="OB91_CycleTime" Type="double">1</ATTRIBUTE>
```

Also change the *SyncTime* (cycle time) for the PROFINET IO-System:

```
<OBJECT Type="SyncPoint">
   <ATTRIBUTE Name="SyncTime" Type="double">1</ATTRIBUTE>
   <ATTRIBUTE Name="SyncID" Type="int">100</ATTRIBUTE>
   <ATTRIBUTE Name="SyncEventName" Type="string">PROFINET IO-System </ATTRIBUTE>
   <ATTRIBUTE Name="SyncType" Type="string">PN</ATTRIBUTE>
   <!--SyncPoint-->
</OBJECT>
```

NOTE

Be aware that changing the cycle time will result in a slower IO communication.

For PROFIdrive components it is recommended to select the same time slice as the mechanical model (e.g. from MCD). Set this time slice to a cycle time which is an integer divisor of the synced cycle time. Best results can be achieved with a low cycle time for the drive components (e.g. 1ms).

5 Known issues and limitations

The following chapter deals with known issues and limitations related to isochronous mode in SIMIT.

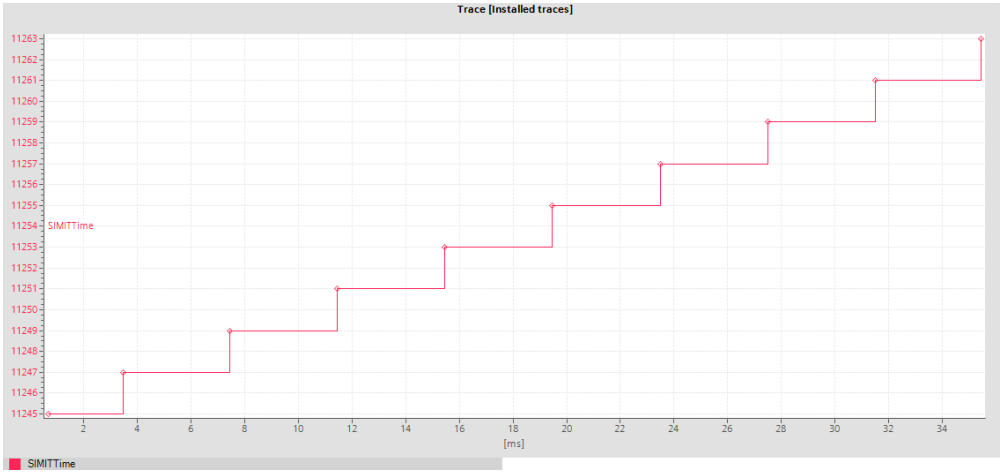
5.1 Synchronizing PIPs in local submodules

Synchronizing to PIP in local submodules of the PLC can lead to communication errors if the same PIP is also used in decentralized periphery. A distinction must be made between the event synchronous OB3X and the bus synchronous OB6X.

A twice used PIP of an event synchronous OB3X or Bus synchronous OB6X on local and decentralized periphery modules will lead to a faster simulation.

The trace in Figure 5-1 shows the results of a counter generated in the simulation. The expected result is a step of 1 every cycle (4ms) but the simulation is running twice as fast which results in a step of 2 every cycle.

Figure 5-1 Trace of a counter in OB30 which is used in local and decentralized periphery



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FAQ:

In STEP 7 (TIA Portal), why is it not possible to configure as isochronous centrally slotted modules in S7-1500 clock-synchronized?

https://support.industry.siemens.com/cs/ww/en/view/109760535

5.2 Failing isochronous connection during download

Using the download button in TIA Portal while the PLC is in RUN might trigger a failure of the isochronous communication between the running PLCSIM Advanced and SIMIT.

The life sign bit of the drive telegram communication might trigger a communication error. Axes will be shut down and the error must be acknowledged. PLC will still be in RUN.

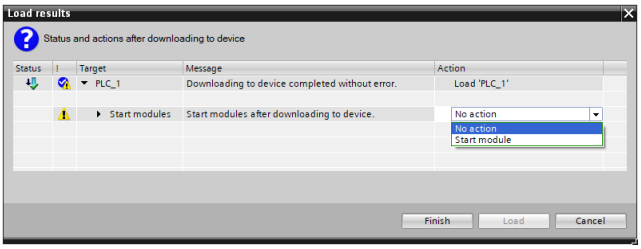
At the exact moment of pressing the download button an asynchronous simulation step of PLCSIM Advanced and SIMIT is triggered.

5.3 Failing PLC start after download

After starting the SIMIT simulation with an empty instance, downloading the PLC project will not set the PLC to RUN. The yellow LED will be flashing.

As workaround, select *No action* directly after downloading (see Figure 5-2) from the TIA Portal. After that, the PLC can be started via the TIA Portal or the PLCSIM Advanced application.

Figure 5-2: Start modules after downloading to device



NOTE This only occurs with PLCSIM Advanced V4.0 SP1.

5.4 Slowed-down simulation

Different cycle times between MC-Servo / OB6X and PROFINET-IO can result in a slowed-down SIMIT simulation. Check the simulation time with the *SimulationTime* component from the SIMIT library (see chapter 4.3 Debugging isochronous issues) to validate the simulation speed (see Figure 4-1). Therefore, compare the progress of the real time with the progress of the simulation time.

It is also possible to check the movement of axes. If they seem to move irregular or too slow use the simulation time method as described above to verify the issue.

Check chapter 4.4 Different Profinet-IO and isochronous OB cycle times if different cycle times are needed. A different Profinet IO and isochronous OB cycle time have a major impact on the simulation time.

Keep in mind that the simulation will always run a bit slower than real time.

5.5 Event Synchronous Mc-Servo

Synchronizing *Event Synchronous* to a *cyclic* Mc-Servo (see Figure 3-1) will lead to a stopped simulation after the first simulation cycle if there is no Synchronous Cycle OB6X in the project.

Add a Synchronous Cycle OB6X to the project to run the simulation or synchronize to the Mc-Servo in *synchronous to the bus* mode (see Figure 3-1) by using IRT and isochronous mode if possible.

6 Further Information

Read me

Further information on isochronous mode can be found via

https://support.industry.siemens.com/cs/bd/en/view/109755401

Some additional and more practical information can be found in the FAQ: Isochronous mode with PROFINET - an example with SIMATIC S7-1500

https://support.industry.siemens.com/cs/ww/en/view/109480489